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ABSTRACT

Reported is a study to examine the relationship between parents', science teachers', and friends' evaluations of science ability - as seen by respondents - and the resulting self-concept of science ability held by eighth-grade females. Data were taken from first-year data of a five-year longitudinal study in progress among the eighth-grade population of the Grand Rapids, Michigan public schools. Only female respondents (N=856) were included in this research. Parent, teacher, and friend evaluations were independent variables; self-concept of science ability was the dependent variable. Information was taken from questionnaires from the Michigan State Self-Concept of Ability Scales. Data were analyzed with percentage tables, the Gamma Measure of Association, and a path model. Four variations of the path model controlling for race and socio-economic position of respondents were also drawn up. The major findings noted a positive relationship between the perceived evaluation of parents, teachers, and friends, and self-concept of science ability. The overall relationship was strongest for teachers, followed by friends; the effect of parental evaluation was the weakest. While parents and teachers were seen as attaching importance to doing well in science, many of them, on the other hand, were seen as evaluating respondents' science abilities as average.
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WHERE ARE THE WOMEN SCIENTISTS? THE ROLE OF PARENTS, TEACHERS, AND FRIENDS IN THE SELF-CONCEPT PROCESS

by

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This is part of a longitudinal investigation of the academic and career developments of an 8th grade class through to their third year after high school, conducted by the Grand Rapids Public Schools/ Western Michigan University - Center for Educational Studies; research project directors: Edsel L. Erickson and Donna M. Kaminski. I wish to thank the Grand Rapids Public School System for providing the data for this study; I particularly wish to acknowledge William Reaves, Director, Office of Curriculum Planning and Evaluation, Eloise Martin, Assistant to the Director, Office of Curriculum Planning and Evaluation, John Dow, Deputy Superintendent, and Cy Dubinsky, Director, Middle Schools.

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ABSTRACT

This study examined the relationship between parents', science teachers', and friends' evaluations of science ability--as seen by respondents - and the resulting self-concept of science ability held by eighth grade females. Data were taken from the first year data of a five-year longitudinal study in progress among the eighth grade population of the Grand Rapids, Michigan public schools. Only female respondents (N=856) were utilized for this research. The questionnaire items were taken from the Michigan State Self-Concept of Ability Scales developed by Wilbur Brookover and his associates. Parent, teacher, and friend evaluations were the independent variables; self-concept of science ability, the dependent variable. Additionally, the perceived importance attached to doing well in science on the part of parents, teachers, and friends was used both as a control and as an intervening variable. Race and socio-economic position of respondents were also used as controls. Theoretical anchoring was in the symbolic interactionist framework which stresses the role of significant others in the socialization process and in the definition and presentation of self.

Data were analyzed with percentage tables, the Gamma measure of association, and a path model. Four variations of the path model controlling for race and socio-economic position of respondents were also drawn up.

The major findings noted a positive relationship between the perceived evaluations of parents, teachers, and friends and self-concept of science ability. The overall relationship was strongest for teachers, followed by friends; the effect of parental evaluations was the weakest. While parents and teachers were seen as attaching

importance to doing well in science, many of them, on the other hand, were seen as evaluating respondents' science abilities as average. When teachers and parents attached high importance to doing well, however, self-concept of science ability was modestly enhanced among respondents. Importance did not function as a meaningful intervening variable. When race and socio-economic position of respondents were controlled, overall, teacher evaluations had the strongest effect. Parental evaluations had the weakest effect, and were negligible for one group.

Further research utilizing additional variables is needed for this age group. To reduce the disparity between male and female scientists structural and institutional changes in the society are implied.

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INTRODUCTION

The limited participation of women in science[1] in this country is by now well documented. A great deal of the research up to this point, however, has focused upon the woman who is already committed to science--either as a college student or as a practicing scientist (see Rossi, 1971; White, 1975; Perucci, 1970; for example). This paper, however, focuses upon a prior point in the life cycle and examines the self-concept of science ability held by eighth grade females and the part played by the perceived evaluations of parents, science teachers, and best friends. The assumption is made that all three of these function as significant others in the realm of science.

The pertinent literature has shown that the conception females have of themselves in the realm of mathematics and science is part of a complex array of variables which has resulted in relatively few women entering these fields. (For the area of mathematics see Kaminski, 1975; Fennema, 1978; for science see Erlick and LeBold, 1975; Kaminski, 1978) Additionally, the literature has shown that parents are in part responsible for their daughters not taking science/mathematics courses and/or considering careers in these areas (see Kaminski, 1975, 1978; Fox, 1976a). This paper examines the part played by teachers and friends as well in an attempt to sort out the relative importance of each in terms of perceived evaluations of science ability.

A curious phenomenon noted in the literature with reference to the subject areas of mathematics and science is that while both sexes perform

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[1]For the purposes of this paper, science refers to the following fields: engineering, comouter specialties, mathematics, and the earth, life, and physical sciences. The behavioral and social sciences are excluded.

at about the same level in mathematics and science in the lower grades, by the seventh and eighth grades the performance level of females begins to drop (Hilton and Berglund, 1974; Maccoby and Jacklin, 1974; Kaminski, 1978, review of the literature). This points to the role of socio-cultural factors and highlights the importance of focusing upon eighth grade youngsters.

Recent data presented in Table 1 is of interest since it not only gives the percentage of women doctoral degree recipients but also compares the five year period 1971 to 1976.

Table 1--Percentages of Women Among Doctoral Degree Recipients, By Discipline Division: Aggregate United States, 1971 & 1976

Discipline Division	1971 Percent Awarded To Women	1976 Percent Awarded To Women	Percentage-Point Gain
Agriculture & natural resources	2.9	6.6	3.7
Architecture & environmental design	8.3	15.9	7.6
Area studies	17.4	31.9	14.5
Biological sciences	16.3	21.5	5.2
Business & management	2.8	5.4	2.6
Communication	13.1	24.5	11.4
Computer & information sciences	2.3	9.4	7.1
Education	21.2	33.4	12.2
Engineering	.6	2.3	1.7
Fine & applied arts	22.2	27.9	5.7
Foreign languages	38.0	47.9	9.9
Health professions	16.5	28.8	12.3
Home economics	61.0	71.3	10.3
Law	.0	3.9	3.9
Letters	23.5	36.5	13.0
Library science	28.2	45.1	16.9
Mathematics	7.8	11.0	3.2
Physical sciences	5.6	8.7	3.1
Psychology	24.0	31.7	7.7
Public affairs & services	24.2	32.0	7.8
Social sciences	13.9	21.6	7.7
Theology	1.9	4.1	2.2
Interdisciplinary studies	15.4	32.2	16.8

Source: George H. Brown, Doctoral Degree Awards to Women, n.d.

As can be noted from the table, although gains have been made by women in a five year period in the computer, information and physical sciences as well as in engineering and mathematics, the percentages remain pitifully small, especially in engineering. The table vividly demonstrates the underrepresentation of women in the science fields of concern to this paper and points up the continuing clustering of women in those fields traditionally perceived as appropriate for women; i.e., home economics, education, library science, etc.

A basic issue now emerging among many social scientists about the continuing underrepresentation of females in the sciences concerns the relative explanatory power of variables. Until recently, innate differences were commonly given to explain the differential performance levels of males and females in various mathematics and science achievement and aptitude tests. Recently, attention has shifted to various socio-cultural variables. Apparently a variety of factors interact to discourage females from considering a scientific career. Some of these barriers are overt; others, covert. These include the following: (1) A socialization process in which dependence and passivity are implicitly and explicitly encouraged and in which success as measured by an objective visible achievement may be perceived as antithetical to femininity (Bardwick and Douvan, 1971; Komarovsky, 1953); (2) A lower self-concept of ability among females even when they are doing well (Wylie, 1961 and 1963); (3) A higher evaluation of males by both sexes (McKee and Sherriffs, 1957 and 1959); (4) A perception of mathematics and science by females as male domains (Ernest, 1975; Fox, 1976a; Ruina, 1973); (5) A reinforcement and perpetuation of gender-role stereotypes in the schools--teachers, books, curricular materials--

(Jay and Schminke, 1975; Trecker, 1974; Howe, 1971; Good et al., 1973); and finally (6) Non-support or perception of non-support by significant others (Hawley, 1972; Bem and Bem, 1974; Kaminski, 1975 and 1978).

Some of the related literature pertaining to the role of parents, teachers, and friends is reviewed. While parental evaluations seem to be highly important before the junior high age, it is possible that in the field of science in the eighth grade the science teacher as expert takes on special significance. The evidence up to this point regarding friends is scanty and inconclusive.

REVIEW OF RELATED LITERATURE

Parents

The socialization process begins, of course, soon after birth when a pink blanket may be pinned on a girl baby and a blue on a boy baby. By a very early age (around six) many children have learned to distinguish between what males and females, boys and girls do; what kinds of behavior are appropriate for each; express appropriate role preferences for self; and behave in accordance with gender-role standards. In a review of the literature Weitzman (1975) notes that while there are discussions of the harsh restrictions placed upon boys, the equally harsh restrictions (but of a different kind) placed upon girls are ignored for the most part.

For one thing, girls are given fewer opportunities for independent action and at a later age than their brothers. Further, pressures may be exerted upon girls to select girls' toys and to be more restrained, quiet, sedentary, and neat in their play than their brothers or boys in the neighborhood; to be gentler and more emotionally demonstrative.

Additionally, girls are held to a more "exacting code of filial and kinship obligations" (Komarovsky, 1953:59).

As the socialization process proceeds, parents have more limited aspirations for their daughters than for their sons, and educational expectations for achievement are less for daughters generally as well as in such subjects as mathematics and science. If parents sex-type mathematics and science and related activities as masculine, these attitudes/beliefs may be communicated to the child explicitly or implicitly (Kaminski, 1975, 1978; Weitzman, 1975; Fox, 1976b; Block, 1973).

Research among female scientists points to the following as possible supportive factors in their excelling and developing a career orientation: (1) An intelligent and mathematically educated father; (2) The intellectual, cultural, and moral values held by both parents (not specified precisely); (3) Relative absence of brothers; (4) Ethnic marginality of parents (one or both born outside the United States). The rationale for the latter variable is that many European societies are not characterized by an anti-intellectualism common to this society (Osen, 1974; Helson, 1975). Generally women see fathers--rather than husbands--as more tolerant of women who enter masculine fields. This suggests a difference between the role of father vis-à-vis daughter and the role of husband vis-à-vis wife, a difference that is of importance in the "cultivation of interests in things scientific and rational during the girls' formative years" (Rossi, 1965:91).

On the debit side the following can be noted: (1) precocious girls generally receive less parental encouragement and support in mathematics/science than do precocious boys; (2) Scientifically precocious girls are

not encouraged to accelerate in their mathematics education as are precocious boys; (3) Even among gifted high school girls there is less discussion about future careers in comparison with gifted boys. When discussion does ensue, traditional female occupations are the focus; and (4) While training in independence seems to be an important aspect of creative, scientific pursuits, this is a devalued trait in females, and one certainly not encouraged in daughters by many parents (Astin, 1974; Rossi, 1965).

Although there are few black female scientists and a dearth of research in this realm (on both males and females) Ladner's work in the black community (1971) suggests that black girls--regardless of social class--are encouraged to be more independent than white girls. They frequently identify with and aspire to the image of the strong black woman. Additional research (Kandel, 1971) notes that black girls consistently have a closer and more intense relationship with their mothers than do white girls in many aspects of family life. Additionally, both black mothers and adolescents have higher educational aspirations for the adolescents than do whites. These differences persist regardless of intactness of family, type of maternal authority, or maternal ascendancy in intact families. Mothers in female-headed families are more likely to stress higher education for their daughters than for their sons.

Teachers

A great deal of evidence exists to indicate that teacher expectations are a powerful factor in terms of self-concept, especially in the mix related to the ascribed variables of sex and/or social class. Frazier and Sadker (1973) refer to teachers as the hidden carriers of

society's gender-role stereotyping; such stereotypic thinking appears to be common among both female and male teachers. Conceivably, teachers are "unconscious sexists" who are not aware of the negative outcomes of their stereotyped attitudes and behavior (Fox, 1976a). A strong case can be made that girls and boys are not treated equally in the schools in terms of teacher interaction and expectations as well as in both general and subject specific (e.g., science and mathematics) texts and curricular materials.

The literature points to the following: For one thing, teachers interact more frequently with boys than with girls, especially in mathematics and science classes (Review of the literature by Fox, 1976a). While boys in general do receive more teacher disapproval in the lower grades (more disapproving contacts, harsh and angry tone of voice by teacher), rather than being discriminated against, boys appear to be more intense or salient stimuli for the teacher. High achieving boys seem to receive the most favorable attention as well as more intense teacher affect and feedback. Secondly, while girls may be either ignored or rewarded for conformity and obedience, strong, consistent pressures are exerted on them to be feminine and good pupils. One consequence of these differential interaction/treatment patterns is likely to be a cumulative increase in autonomous independent behavior by boys and a lowering of self-esteem for girls as girls not only receive less attention but are criticized more for their lack of skill and knowledge. Finally, from kindergarten on, many teachers make the assumption that girls are going to love reading and hate mathematics and science. Further, girls are not expected to think logically nor to understand scientific principles (Howe, 1971; Levy, 1974; Frazier and Sadker, 1973; Sears and Feldman, 1974; Good et al., 1973).

Analyses of text and curricular materials utilized in the schools indicate that these seem to reinforce traditional gender-role typing in the following ways: (1) Men and boys appear more frequently and in a greater variety of roles in which they exhibit traits positively evaluated by the society; e.g., competitiveness, bravery, ingenuity, and strength. Boys are depicted as "doers" in other words; (2) Women and girls not only appear less frequently, but are shown in a narrow range of stereotypical roles. Girls exhibit such devalued traits as dependence, fearfulness, docility, and passivity. Girls, in other words, are "onlookers"; (3) Although the "new math" may have brought new mathematics concepts, a lot of the old social ones have been retained. The implicit message in texts is that mathematics and science are male domains; females need not apply. As with the general materials, females are shown as helpless incompetents who have difficulty adding, and utilize mathematics only in dividing pies or grocery shopping. Since teachers do play a pivotal role in this area, they might minimize role stereotyping by using non-stereotyped exercises and activities; by including materials on female scientists and mathematicians; and by utilizing female role models for classroom speakers (Jay and Schminke, 1975; Weitzman et al , 1972; Federbush, 1974; Rogers, 1975; Frazier and Sadker, 1973; Women on Words and Images, 1974; Levy, 1974; Howe, 1971; Trecker, 1973; Saario et al., 1973; Weitzman and Rizzo, 1974).

Peers

The point of view generally taken is that the peer group is not an agent of deliberate socialization, but that its members enjoy peer group interaction for its own sake. Nonetheless cliques may, unintentionally or otherwise, exert a great amount of pressure on their

members to acquire the values, orientations, and outlook of the group. Certainly as youngsters approach the junior and senior high years and members of the opposite sex are seen as potential dating material, traditional role appropriate behavior comes into play. The costs to a young female defined as unfeminine and/or engaging in non-traditional behavior may be high (Clausen, 1968; DeFleur et al., 1973).

Weitzman (1975) contends that the school and parents as well as peers make it clear to the young female that the only criterion for feminine success is attractiveness to males (This is reinforced by the mass media). Certainly there is some support for the position that equates intellectual success with a loss of femininity among high school peer groups. Some research notes that a decline in career commitment among high school females is related to male classmates' disapproval of the use of female intelligence (Mathews and Tiedeman, 1964; Hawley, 1972).

Brookover and his associates in their six year study of junior and senior high school students (1962, 1965, 1967) suggest that overall, perceived parental evaluations of students' academic ability are more highly related to the students' self-conceptions of their ability in this realm than are friends or teachers although there was variation depending on grade level. The proportion of students naming friends as significant others increased somewhat during the six year period as did the influence of friends on students' self-concept of ability. Less than half the students identified teachers and other school personnel as significant others in junior high; the proportion declined in later years. In somewhat similar research on general academic ability among Grand Rapids eighth graders Franklin et al. (1978) found

perceived parental evaluations of greater salience than teachers, which, in turn, were greater than peers.

THEORETICAL FRAMEWORK

The framework which undergrids this paper stems from the symbolic interaction framework within the Meadian tradition as amplified and extended upon by John Kinch (1963) and more especially, Wilbur Brookover and his associates (1962, 1965, 1967); the latter have contributed theoretical insights and empirical data regarding the self-concept of ability construct. This construct flows out of a more general model delineated by Brookover and Erickson (1975) in which the self-concept is seen, not as a trait which one has or possesses, but as a defining behavioral process. Within the symbolic interaction framework appropriateness of behavior is seen as defined by humans through the internalization of the evaluations and expectations of significant others; each person, therefore, including young females, develops a definition of appropriate behavior in each significant situation. As part of this process humans assess their competency to carry out the behaviors appropriate for a particular role. As young females define their ability in a role, a self-concept of ability, which functions as a threshold variable in terms of future performance, develops (Brookover, 1959; Brookover and Erickson, 1975).

Further, both Mead (1934) and Blumer (1969) stressed the salience of the meanings that are attached to the actions and evaluations of others (especially significant others in the person's social world). As noted, females, in organizing their own behavior, take into account the meanings attributed to that behavior (verbal and otherwise) as well

as their perceptions of the way others view them. If females feel that they are evaluated by parents or teachers as not very bright in science; or if peers are seen as viewing science as an unfeminine interest, this has important implications for a young female's self-concept of science ability. Conceivably, this could lead to not doing well in science or not taking science courses. Role-taking is an important part of the perceived evaluation process as experienced by young females.

Both the theoretical and the empirical literature suggest that significant others are not necessarily the same from one situation or role to another. The significant others of a female playing the role of physics student are not likely to be the same as for that same person in the role of dancer or cross-country skier. In the area of general academic ability, Brookover and his associates note the importance of perceived parental evaluations (1962, 1965, 1967). One of the concerns of this paper is whether perceived parental evaluations are also important in the subject-specific area of science and to assess the relative importance of perceived teacher and friend evaluations as well.

RESEARCH DESIGN

This study involved the eighth grade female population (N=856) of the Grand Rapids, Michigan public school system in 1976-77. A questionnaire was administered to all eighth graders (N=1721) as the first year of a five year longitudinal study examining a host of variables. The questionnaire was based on items and scales developed by Wilbur Brookover and his associates (1962, 1965, 1967) at Michigan State University.

Questions pertaining to the self-concept of science ability, the perceived evaluations of science ability on the part of the parents,

science teachers, and best friends, and the perceived importance attached to doing well in science on the part of these same significant others were used by the researcher out of the larger questionnaire (perceived evaluation and perceived importance will henceforth be referred to as evaluation and importance). Evaluations were the independent variables; self-concept of science ability, the dependent variable. The latter was measured by two items from an eight-item self-concept of science ability scale designed by Brookover and associates (1962, 1965, 1967). Researchers have noted a high degree of consistency among items when items have been taken out of the complete scale (Throckmorton, 1975). Additionally, importance was used both as a control and as an intervening variable. Seven hypotheses and three sub-hypotheses were drawn up to test the relationships between the independent and the dependent variables.

The data were analyzed by the use of percentage tables, the Gamma measure of association, and a path model. Four variations of the path model controlling for race and socio-economic position of respondents were also utilized. Respondents were dichotomized into white or minority for the racial category (84% of the minority youngsters were black, with a small representation among Hispanic, Native American, Oriental, and other).

Additionally, the Duncan occupational scale (Reiss et al., 1961) was used for the socio-economic variable. To dichotomize, the choice of cut-off points was based upon the percent of respondents in the range of occupations. An attempt was made to use cut-off points that reflected a division of the population into halves. Thus, the Duncan Scale values ranging from 02-23 included approximately one-half (48%) of the respondents, and those ranging from 24-96 included 52% of the

respondents. Therefore, respondents whose parental occupations fell within the 02-23 range were categorized as of low socio-economic position; those whose parental occupations fell within the 24-96 range were categorized as of high socio-economic position. It is apparent that the high socio-economic category encompassed a wide range of occupations. This is a reflection of two factors: (1) Grand Rapids is generally considered a "working class" city and (2) Many middle and upper-middle class youngsters attend the Christian Reformed School, and thus are "siphoned off" from the public school route.

FINDINGS

Percentage tables, the Gamma measure of association, and the path model are discussed.

Table 2 presents the frequency distribution of responses for parents, teachers, and friends on the evaluation variable. The following can be highlighted: (1) Respondents most frequently (roughly around 50%) see parents, teachers, and friends as rating them about the same as other eighth grade students with reference to work they can do in science; (2) Roughly one-third of the respondents see parents, teachers, and friends as rating them better than other eighth graders; (3) In contrast to parents and teachers, friends are more frequently seen by respondents as rating them the same as or poorer than other eighth graders; (4) Few significant others are seen as rating respondents either as "among the best" or, more especially, as "among the poorest."

Table 2--Parental, Science Teacher, and Best Friend Evaluations of Science Ability as Seen by Eighth Grade Female Respondents

	Parents		Teachers		Friends	
	N	%	N	%	N	%
Among the Best	84	10	86	10	74	9
Better than other 8th grade students	291	34	325	38	259	30
The same as other 8th grade students	452	53	411	48	495	58
Poorer or among the poorest	29	3	34	4	28	3

Table 3 presents the frequency distribution of responses for parents, teachers, and friends on the importance variable. The following can be noted: (1) Roughly four-fifths of the respondents see their parents and teachers as considering doing well in science as important or very important. However, only slightly more than one-third of the respondents see their friends as attaching importance or high importance to doing well; (2) While only one-fifth or less, on the other hand, see parents and teachers as not attaching much importance to doing well in science, nearly two-thirds see their friends as not attaching much importance; (3) Overall, then, the pattern for friends' responses is different from that for parents and teachers, with friends seen as attaching less importance to doing well.

The distribution of responses for parents, teachers, and friends on the evaluation variable (Table 2) and on the importance variable (Table 3) highlights a difference. While at least 80% of parents and teachers are seen as attaching importance to doing well in science, less than half are seen as evaluating respondents' science abilities highly.

Table 3--Parental, Science Teacher, and Best Friend --- Importance Attached to Doing Well in Science as Seen By Eighth Grade Female Respondents

	Parents		Teachers		Friends	
	N	%	N	%	N	%
Very important	279	33	229	27	50	6
Important	456	53	462	54	249	29
Not too important	110	13	133	16	410	48
It doesn't matter at all	11	1	32	4	147	17

Additionally, the Gamma measure of association was used to test the bivariate relationship between parental, teacher, and best friend evaluations and self-concept of science ability. The Gammas are reproduced in Table 4.

Table 4--Association Between Parental, Science Teacher, And Best Friend Evaluations and Self-Concept of Science Ability Held By Eighth Grade Female Respondents

	Gammas
Parents	+.49
Teachers	+.56
Friends	+.54

As can be seen from Table 4, in all cases the relationship is a positive (direct) one. Although the size of all three Gammas is similar, the Gamma for teachers is largest; that for parents, the smallest. The relationship for parents is of moderate strength, tending toward substantial, while the relationship for the other two is of substantial strength (Davis, 1971). Although the tables are not reproduced here, it can be noted that the distribution of responses for all three sets of significant others is in the expected direction and lends support to the salience of parental, teacher, and friend evaluations in a young female's perception of self in the realm of science.

Findings from the path analyses in which multivariate relationships were examined were consistent with the findings which examined bivariate relationships. Parental, teacher, and best friend paths for all variations are reproduced in Table 5.

Table 5--Parent, Science Teacher, and Best Friend Evaluation Paths, All Path Variations

	All Respondents	White Females Low SES	White Females High SES	Minority Females Low SES	Minority Females High SES
	N = 856	N = 209	N = 349	N = 203	N = 95
Parent Evaluation → Self-Concept	.1026	.1462	.1565	.0113	.1525
Teacher Evaluation → Self-Concept	.3043	.2753	.3117	.2721	.3050
Friend Evaluation → Self-Concept	.2368	.1674	.2613	.3221	.1265

The following can be highlighted: (1) Overall, the teacher evaluation paths are the strongest, followed by friends; the parental paths are, overall, the weakest; (2) Only one path--the parental path for minority females of low socio-economic position--is too weak to be meaningful; (3) The friend path is strongest for minority females of low socio-economic position and for white females of high socio-economic position; (4) Although all paths are positive, the size of the path weights indicates that many other variables are also involved.

Finally, when the importance variable was dichotomized into high and low importance on the part of parents, teachers, and best friends,

self-concept of ability was modestly enhanced in the relationship with teachers and friends (the difference between the Gammas in both cases was +.07). No difference was found for the Gammas for parents. Also, no support was found in the path model for importance as an intervening variable between parental, teacher, and friend evaluations and self-concept. In all cases the path weights were too weak to be meaningful.

DISCUSSION

While a positive relationship between parental, teacher, and friend evaluations and self-concept of science ability was found, the importance of science teachers' evaluations has been underscored. The assumption made in the symbolic interaction framework that the evaluations--perceived or actual--of significant others do play an important role in the self-evaluation process has been supported. Conceivably, this is especially crucial for females since--as the socialization literature attests--their view of self emanates from the evaluations of others, and they may be especially attuned to cues from significant others. The fact that many of these youngsters feel their parents and teachers see them as having average science abilities but feel that parents and teachers attach high importance to doing well may simply reflect an emphasis on the part of these adults upon grades per se. This may, in other words, not be unique with reference to the area of science but may hold for other academic areas as well. Also, the point should be emphasized that even though the relationship between parental evaluations and self-concept of science ability was the weakest of the three, this should not obscure the fact that parents play a highly important role in the general socialization process

and in defining and reinforcing gender appropriate behavior and attitudes.

As noted, in subject-specific areas such as science it is possible that teachers become particularly relevant during the junior high years. Students typically have a special science teacher who may be seen as an expert. While parents may claim and be perceived as experts in some other academic areas (as in reading and English), it is possible that most parents do not claim (nor are they so perceived by their youngsters) expertise in science. It is quite possible that the science teacher as expert may do the initial labeling and defining of the youngster. Parents, in turn, may take these assessments by the teacher as their own. If the science teacher, for example, proclaims to parents that "Beth is not very good in science," this assessment may be internalized by the parents themselves without any questioning. Beth may ultimately have a very negative conception of her own science ability, and possibly, about science generally.

In related literature, Fox (1976a) notes that not only do high school teachers appear to hold different expectations for males and females in mathematics, but precocious female students may be perceived in a negative and even hostile fashion by these teachers. It is also possible to point to very fragmentary evidence (Anderson, 1963) noting that students who have an "inspirational" teacher tend to rate themselves higher in mathematics and science.

The fact that all of these youngsters regardless of racial and socio-economic category perceive teacher evaluations as meaningful underscores the potential role that science teachers might play in terms of encouraging young females to take science courses or even

consider a career in a science field. While there is no necessary relationship between self-concept of science ability and interest in a science career (this awaits further research), two research efforts bearing on this point merit comment. Kaminski (1978) found that for both male and female high school students a significantly greater proportion of the high self-concept than the above average self-concept students selected an advanced science course in high school. While taking an advanced science course does not necessarily lead to preparing for a scientific career, provocative questions are raised. Likewise Erlick and LeBold (1975) found that for those high school students of both sexes who were even considering science or mathematics careers, all reported above average assessments of themselves on mathematics, mechanical, problem solving, and science ability. Perhaps not surprisingly, both Kaminski and Erlick and LeBold found more males than females rating themselves high in science ability.

Additionally, the role of friends in the evaluations-self-concept process has been highlighted, more so for some youngsters than for others. The fact that best friends are seen as not attaching as much importance to doing well in science may have implications for discouraging females from doing well in science or in considering science careers. Conceivably, if friends view doing well in science or pursuing a scientific career as unfeminine (one can only speculate in this realm as the research does not bear directly upon this point), this may mean that the youngsters themselves do not attach importance to doing well. Not electing to take science courses later on in the school career or having poor grades in those courses taken may possibly function as critical filters for science careers (Ernest, 1975; Sells, 1974).

While the overall importance of teacher evaluations has been underscored, the following caveats of Brookover and Erickson (1975) are worth emphasizing: (1) No conclusion is warranted that one set of significant others does not have any influence or cannot increase its influence; (2) The perceived evaluations of all three sets of significant others account for some of the variation; and (3) Parents, teachers, and best friends are often seen by youngsters as sharing the same evaluations.

RECOMMENDATIONS FOR FUTURE RESEARCH

An assumption has been made in the present research endeavor that having more females take science courses and enter science careers is a desirable state of affairs. As noted, there is, however, as yet little evidence to suggest a necessary relationship between self-concept of science ability and aspirations for a career in science. In attempting to relate this research to the larger society, however, a point to be stressed is that if young females are interested in pursuing a career as a physicist or chemist or whatever, options for entering non-traditional careers should be available to them. Conceivably, a great loss is incurred when females are discouraged from taking science courses and/or considering a career in science. That some young females will opt for a career within a traditional field or a full-time homemaking career is, of course, their prerogative. But these females should be aware that other options do exist, and that these options, at least in some cases, are viable ones.

While research is forthcoming, at this point in time little data is available on this age group of youngsters for self-concept with

reference to science and mathematics skills or abilities. The following additional variables with reference to the educational system might be germane: Sex and race/ethnic membership of teacher, school climate, role of school counselors, expectations of teacher. The following familial variables might provide helpful insights: Social class and race/ethnic membership; structure (one or two parent); whether mother is employed outside the home and kind of employment. Actual interviews with parents, teachers, and friends as well as with respondents themselves would provide additional insights as well. Conceivably, incongruencies may exist between perceived and actual evaluations. For example, do parents, in fact, not perceive themselves as experts in science; do friends, in fact, view doing well in science and aspiring to a scientific career as unfeminine interests or is this an assumption made by young females?

Certainly increasing dramatically the number of female scientists in this society implies many changes. As has been noted (Chafetz, 1978), the elimination of the "sexual caste" system and of gender-role stereotypes rests upon bringing about changes in the value premises underlying the stereotypes. The question of how fundamental value changes can be wrought is, at best, a difficult one and has not yet been answered. One can focus efforts at the micro level, but social/structural changes at the macro level are needed if social changes are to take place. While the interaction patterns in isolated dyads can be changed (teacher-student; parent-child), the effect will be nil unless structural patterns and arrangements are modified and changed.

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